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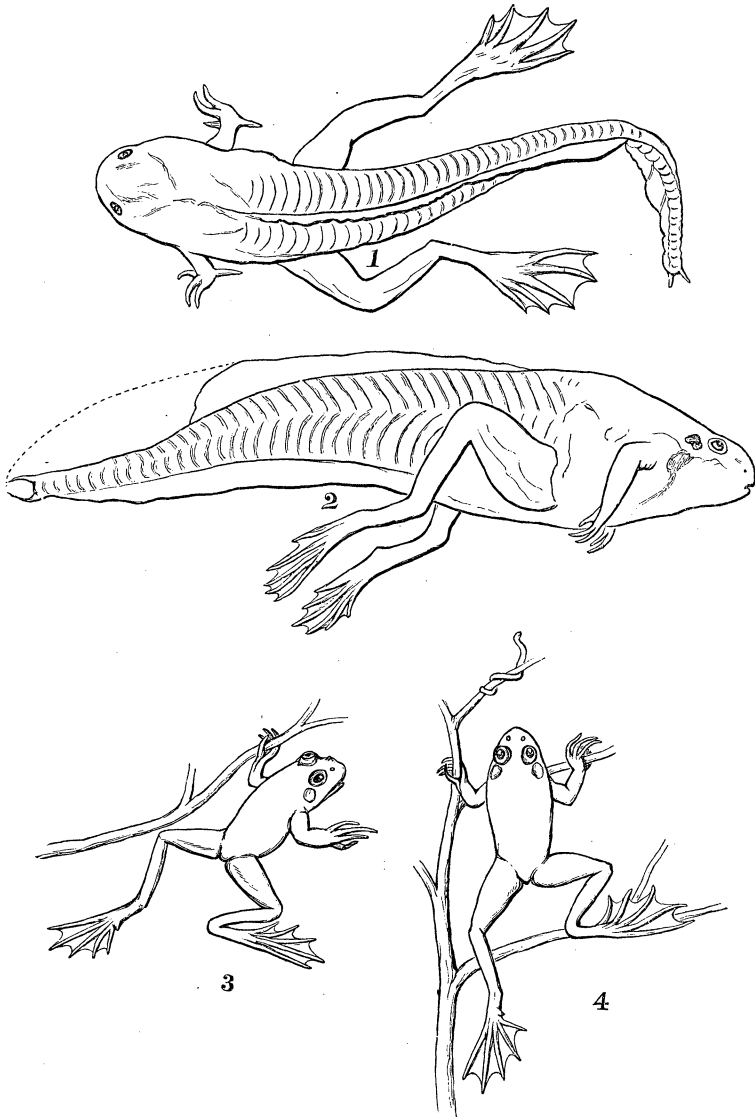
The uniformity of trend in glacial striæ and drift transportation observable over wide regions appears inconsistent, at first view, with the supposition that the ice-cap had but little erosive power: a contradiction seems implied in the possession by a glacier of a magnitude and rigidity which enabled it to move without deviation over prominent reliefs, and a general inability to erode those reliefs. How can we harmonize the lightness of its tread with its rectilinear march over uneven surfaces? That ice in glacier masses behaves essentially as a very viscous liquid is well known; and a solution of the problem is found in a peculiar condition, pointed out by many writers, and necessarily existing in a continental glacier, which limits the freedom of motion among themselves, possessed by the different portions of the ice-sheet, to a vertical direction. Lateral deviation is rendered impossible by the inferior plasticity of the ice; and hence, when any portion of the ice-sheet encounters an obstacle, around which it would flow if sufficiently fluent, it is found easier to overcome the gravity of a small mass of ice than the cohesion of a relatively large mass, and the ice, moving in the direction of least resistance, passes in a vertical plane over the obstruction.

PSEUDIS, "THE PARADOXICAL FROG."

BY S. W. GARMAN.

PSEUDIS is a peculiar South American frog, peculiar in the fact that it grows smaller as it becomes adult, and in possessing a nearer approach to a thumb than any of its relatives. It is much to be doubted whether there is anything in the actual history of an individual belonging to this genus that calls for an amount of notoriety to which the most common toad or frog may not aspire. To be sure, the tail is kept long after all the legs appear; the tadpole is larger than the adult, and the creature has a hand in which the thumb is opposed to the three fingers, yet all these are hardly enough to demand the amount of attention of a certain kind which the genus has received. In fact, as often happens in the case of men, *Pseudis* owes much of his reputation to a mistaken estimate. If we might trace him from as early a period as men have seen until well advanced in life, we should probably see nothing more than takes place in the history of all batrachians. We might meet the egg first coming within the limits of our vision as a round, granule-like body be-

tween the cells of the corpus graffianum in the ovary. It would gradually acquire a membranous covering and a germinal vesicle



(FIG. 97.) PSEUDIS.

1, 2, *Batrachichthys*, from Ann. Mus. Nac. Rio de Janeiro, Vol. I., Pl. VI.
[3, 4, *Pseudis minuta*, from Nature.

with the inclosed germinal dot; or, better stated according to Agassiz's nomenclature, it would appear as an ectoblast contain-

ing a Purkinjean vesicle (mesoblast), within which rests a Wagnarian vesicle (entoblast). If we were to follow the egg closely through its different conditions we should see it dropping from the ovary at maturity, passing to the mouth of the oviduct, and through it thrown out into the waters at the same instant that it receives the life-imparting sperm from the male.

If Newport did not mistake, we might see the snake-like spermatozoön work its way through the envelopes to the surface, where, breaking into granules, its identity is lost in the substance of the yolk. Then we should notice the beginning of segmentation, its progress, and the successive changes of form in the embryo, until it tears the shell, and with great, wondering eyes stares out upon its watery world a tadpole. While a big-headed slender-tailed tadpole we should find much of interest in the *Jackie*, as called at home, but in the main the story might be told with approximate accuracy from one secured in the nearest pond. After leaving the shell his manner of life would resemble in most respects that of any other passing through the same stages. He might be seen at one time busily engaged grubbing along on the bottom for whatever eatable might come in his way (and he is not at all particular as to his food), or with many companions lying quietly at rest, starting every now and then like the Turk from his dream, rushing frantically to the surface for a mouthful of air, then tearing back as if his very life depended upon haste, placing himself on the mud as before, just as if nothing whatever had happened. At another time, with a whole group of his fellows, he would be seen to start upon an extended migration as though he had determined to leave the scenes of his youth forever behind him. Often he might be observed to gnaw for some moments at the sides of the leaves of the water-plants, all the while wagging his tail and appearing as jolly as if he had as much real enjoyment in eating as a pig or dog. Then again he would be seen to take a nap with his nose just against the surface of the water, and on being waked suddenly to bury himself deep in the ooze below.

But all the time he would have nothing in the world to do but eat and grow and keep out of the way of hungry enemies. He would eat to some purpose and grow to a size considerably greater than that of the adult. In the mean time the hind legs, with the broad-webbed feet appear, and the arms and hands with the peculiar thumbs. Here he rests for a time as if altogether uncertain whether further change is for the better. In fact, he

loses by the next change, for when it has passed he is smaller than when it began.

His first mention in literature takes him up at this period. Through some Dutch collectors in Surinam, Albert Seba secured specimens of the adult and of the large larvæ with and without limbs. Comparing the smaller with the larger he came to the conclusion that the development was retrograde: that the animal was first a frog, then acquired a tail, then lost its limbs, and finally — the remote resemblance between the coils of the intestine and the sucking disk of the gobies probably suggesting the idea — became a fish. His conclusions with sketches were communicated to Mlle. Marie Sybille de Merian, who published them in her work on the Insects of Surinam, citing Seba as the source. The latter published the same a few years later in his *Thesaurus* (volume i., plate 78, 1734), where he gives a series of figures illustrating the transformation of the frog into the fish. This version of the story was at first accepted by Linné (*Mus. Ad. Fridr.*, 1754) and by Edwards (*Phil. Trans.*, volume li.). In the tenth edition of the *Systema Naturæ* (1758–59) Linné corrects the matter, and the name *Rana piscis* of Merian gives way to *Rana paradoxa* Linné. From that time until within a year the "frog-fish" seems to have known his place. Wagler, in 1830, applied the name *Pseudis*, on account of the errors into which the early observers were led, and the genus then established under this title has been generally accepted by authors.

Last year a chapter was added to the history of the "paradoxical frog," which refers us back to the beginning. Page 31 of the *Archivos do Museu Nacional do Rio de Janeiro*, volume i., 1876, second and third trimesters, contains an article with this title: *Nota descriptiva de um pequeno animal extremamente curioso e denominado Batrachchythis*, by Dr. Pizarro. From the description and the figures on plate vi., it is not difficult to recognize our old friend the young *Pseudis*, of whose peculiarities the doctor does not seem to have been aware. There is little doubt that *Batrachichthys* — to whom the author calls the attention of Messrs. Darwin, Haeckel, and Martins — will ultimately go through his transformations, become a veritable *Pseudis*, and be degraded from his position as connecting link between fishes and batrachians. Should he go no further, as is barely possible, he would even then be only a link between the adult and the tadpole, and no more closely allied to the fishes than either. In this case, which is only a supposition, his standing

would be to the frogs just what that of the axolotl is to *Amblystoma*. What information the author has given us with the description and figures of the single specimen that has come to his notice will not allow the assumption that the representatives of the genus in Paraguay differ from those in Surinam in respect to the length of time passed in the larval stage. It is well known, however, that in other batrachia the metamorphosis can be hastened, or retarded, or prevented, as may be desired; that the time varies in different seasons and localities according as they may be favorable or otherwise; and that in species of a single genus, as *Rana*, the metamorphosis occupies weeks in some cases, years in others. Dr. Jeffries Wyman is said to have kept larvæ of the bull-frog seven years, more than twice the ordinary period of existence of the animal in the larval stage. More information concerning the species of *Pseudis* (*P. paradoxa*, *P. minuta*, and possibly a third for *Batrachichthys*) is desirable.

A little exercise of imagination enables one to see them grasping and swinging from the branches of the plants by means of the opposable thumb; whether this is its use is a question. One can imagine the tail and feet both required in the pursuit of rapidly moving prey or in escape from lively enemies, but it is only supposition.

However, we shall wait another chapter in the history before accepting *Batrachichthys* as one of the "missing links;" the reputation of *Pseudis* as a deceiver is too well established.

ON THE ANCIENT AND MODERN PUEBLO TRIBES OF THE PACIFIC SLOPE OF THE UNITED STATES.¹

BY EDWIN A. BARBER.

IN the far Southwest, covering far the greater part of that section of the United States now known as Colorado, Utah, New Mexico, and Arizona, and stretching through the great valleys of the Rio San Juan and its tributaries, the Colorado and the upper portion of the Rio Grande del Norte, there exist the ruins of thousands of stone structures, built by a prehistoric race whose individuality has been lost in the obscurity of past ages. The great extent of territory which the remains cover, and their great number, would indicate a former population of at least half a million souls.

¹ Read before the American Association for the Advancement of Science, at Buffalo, 1876.